

Twenty Products From Apples

By J. J. Willaman

WHAT can we do with apples besides keeping a doct or away (where there is a doctor)? The accompanying chart shows 18 products now produced commercially in the United States and three others, within dotted boundaries, that may become commercial products. There is no pretense here of making an accurate count of the products since personal opinion counts more than anything else. For example, the enthusiast for apple pie might claim, "Of course, apple pie is a major product from apples." Do you know how many apple pies are made in this country every year?" Then there is jelly mincemeat, brownberry pudding (I vote for it) distilled apple butter, candy, and so on. In other words, the cookbook. At any rate, the apple is a versatile fruit, and it is becoming more so as the result of research in industry and in Federal laboratories both here and in Canada. The purpose here is to discuss what may be called the primary apple products, mainly some of the newer ones.

THE FLESH OF THE APPLE

When apples are peeled and cored (this is done mechanically in industry), two products result, the flesh and the refuse. When ground and pressed, the refuse becomes the pomace. The latter will be discussed below. From the flesh a great variety of products arises. Slices or sections are evaporated to about 25 per cent moisture to give the long-familiar "dried apples." Or the flesh is broken up into smaller pieces and really dried, so that the product is brittle. These are apple nuggets, which are finding a place in army cookery. The fresh slices may be treated with salt or some other chemical to prevent browning and delivered promptly to pie bakers; or they may be frozen and delivered to the market in cans. Some canned product may be in the form of pieces (canned apples), or in the form of sauce. Of all these relatively new ones are nuggets and the fresh and

A manufacturer can expect to produce, and to have eight months later, a good-quality juice if he uses good apples in the first place, if the acidity of the juice is between 0.5 and 0.6 per cent; if he leaves the juice cloudy instead of filtering it clear; and if he handles it promptly, with as little time as possible between press and container, packs it in enameled tin or glass, and stores it in a cool place.

It might be of interest to describe the "typical U. S. apple juice;" that is, the composite of all juices submitted. It can be described as follows: It was made from a blend of Baldwin, Red Delicious, Jonathan, Northern Spy, and Winesap apples taken from common storage. The Brix was 13.5, the acidity 0.5 per cent, tannin content 0.01 per cent. It was clarified by enzyme treatment. It was not deaerated. It was pasteurized at 185 deg. and was packed in 20-ounce enameled cans. After six months' storage it was weak in typical apple flavor.

The plant that made this juice had a capacity of 70,000 gallons per month, and it made a

plant scale of 50 gallons of juice per hour. The juice should be pressed from sound apples, because any volatile off-flavors in the juice are also recovered. Since the characteristics of the flavor, including the aroma, are dependent upon the variety of apples used, blending different varieties should be taken into consideration as a means of controlling and improving the flavor of the product.

To obtain approximately 10 per cent vaporization, the juice is heated to about 320 deg. F. under pressure, then released into an atmospheric-pressure flash chamber. The flashing operation produces an intimate mixture of vapor and liquid, which are easily separated in a simple chamber; the juice flowing out the bottom and the vapors going out the top. In the flashed vapors, the volatile flavoring constituents are present in a concentration approximately 10 times that of apple juice. They are further concentrated in a fractionating column. In the pilot-plant column, a depth of $3\frac{1}{2}$ feet of porcelain Raschig rings of $\frac{3}{8}$ -inch diameter was sufficient to effect a 10 to 15 fold increase in concentration of volatile flavoring constituents, that is, from 100 to 150 times that of the original apple juice.

One of the most obvious uses of a natural apple flavor is its addition to a concentrated juice. From the latter a full-flavored, natural apple juice can be reconstituted by the addition of water. The reconstituted juice is indistinguishable by taste and bouquet from the juice freshly pressed from the apples. Other uses will undoubtedly occur to persons in the food industry. Since much of the apple juice evaporated commercially goes into products in which natural apple flavor is of no value, the volatile flavoring constituents now discarded in the preparation of these products could by this new process be obtained in concentrated form and sold as a flavor essence. It is probable that



Photo U. S. Department of Agriculture.

Pilot-plant equipment at the Eastern Regional Research Laboratory for development of new products from apples.

APPLE ESSENCE

The taste of foods is partly due to their odor. This is especially true with apples. Juices from

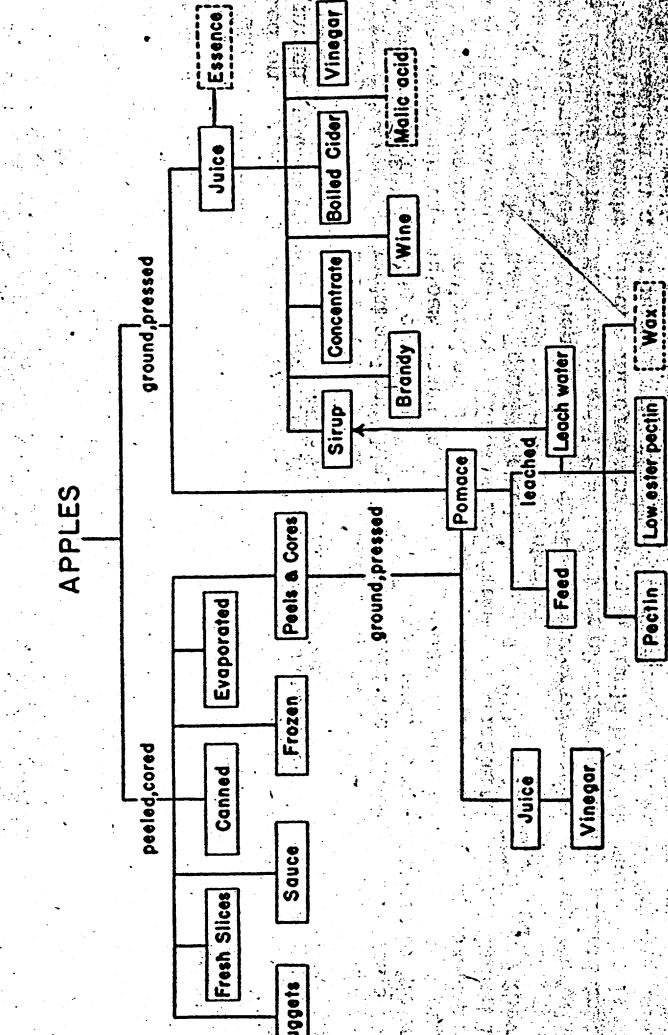
JUICE A great tonnage of apples is ground and pressed, resulting in juice and pomace. In many cases the process stops right there, the juice being drunk within a few days, with or without doughnuts, and the pomace thrown away or fed to the stock. Sizable industries, however, have been built on the further use of both the juice and the pomace. For example, some 4 million gallons of juice are canned or bottled annually in this country, and at least 1.5 million gallons in Canada. Many other millions are converted into the various products shown in the chart, such as vinegar, brandy and the various sirup-like products. The problem in processing juice is to maintain the delectable quality of the fresh juice until the next Summer,

which we are looking for. Many thirst quenchers. Many factors can enter into the item called "quality," which we define as "typical apple flavor." Several years ago, surveys were made of all the apple juice commercially processed in this country, with information on the varieties of apples, kind of storage, container, method of sterilizing, and sugar, acid and tannin content; then the samples were judged for typical apple flavor on a scale of one to five. Unfortunately, from the data, it could not be exactly determined what items make a good or a poor juice, but certain trends were evident. From these other data, we can generate as follows:

APPLE ESSENCE is partly due to the odour of the fruit itself, and partly to the juice with apples. Juicy esters have been lost or re-

er tastes like apple juice. And volatile ingredients are easily lost, products lack flavor. The idea occurred to us that if this essence were concentrated in a concentrated form, it could be added to flavor various foods, or even the flavor of certain apple products had a certain measure of success, and the process is now ready for consideration. The following information sheet was taken from the information sheet published by this laboratory.

APPLE PRODUCTS



stituents now discarded in the preparation of these products could by this new process be obtained in concentrated form and sold as natural flavoring essence. It is probable that the processors of apple juice, such as vegetable manufacturers, will want to avail themselves of this means of recovering a valuable product.

BOILED CIDER, CONCENTRATE AND SYRUPS

Various products of sirupy consistency are made from apple juice. They are distinguished as follows: If the juice is boiled down in an open vessel, the product is boiled cider, and is rather dark and strong tasting. If it is evaporated under vacuum, the product is called concentrate, and is lighter in color and milder in flavor, although still sharply acid. If the acidity of the juice is removed or neutralized and the juice evaporated in vacuum, one of several types of apple sirup is produced.

Apple sirup made by the present commercial

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graph TD
    Juice --> Essence
    Juice --> BoiledCider[Boiled Cider]
    Juice --> Vinegar[Vinegar]
    Juice --> MalicAcid[Malic acid]
    BoiledCider --> AppleWine[Apple Wine]
    Vinegar --> SulfuricAcid[Sulfuric Acid]

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acid) to a pH of 5.0 to 5.5, and then evaporated under vacuum, to a sirup containing approximately 75 per cent of solids. Its consistency is about that of an invert sugar sirup of the same solids content. At 75 deg. F. its viscosity ranges from 800 to 1100 centipoises, with an average of about 1000. This apple sirup is the one used commercially for conditioning tobacco products. A better table sirup is made by removing the acid instead of neutralizing it. This is done by passing it through columns of ion-exchange resins. Malic acid could be a by-product of this process, but it has not been done commercially as yet.

In any process of evaporation, the volatile flavors, or essence, are lost. The essence described can be returned to any of the sirupy products, but obviously it would not help much in boiled cider. In concentrate, however, which still contains the acid, mere dilution with water brings back the original juice practically unharmed. We think there is a future for concentrate "spiked" with the essence.

PECTINS

For many years, housewives and manufacturers of commercial jelly and jam have been familiar with pectin. To the chemist it is known as high-ester pectin, but to the trade it is just pectin. It forms a firm jelly when used in a juice containing 65 per cent of sugar. Apple pomace is dried by the thousands of tons for use by pectin manufacturers. Within recent years, another type of pectin, called low-ester pectin, has been developed. It differs from the older type in that, if a little calcium is available in the juice, a jelly will form without the required 65 per cent of sugar. Thus, jellied fruit desserts and aspics can be made with it with a small proportion of sugar, or none at all.

Jellies made with 35 to 45 per cent of sugar have more of the natural fruit flavor than those with the customary 65 per cent. They are attractive products, but there is one drawback in their use. A 65 per cent sugar jelly is self-preserving, in that micro-organisms do not grow in it, whereas, a jelly with less sugar must be packed sterile, and after opening must be consumed rather shortly. At present, low-ester pectin is used in making a canned jellied fruit dessert. This can be sterilized in the can in the conventional manner, and removed as a jelly ready to serve. This procedure cannot be used with a gelatin product, since it will not solidify after the sterilizing heat treatment. The Army is leading the way in the acceptance of this article.

Thus, the newly-pomace juice from either peels and cores or regular juice pressing finds its way ultimately into delectable bread spreads or appetizing desserts.

One further product from the pomace might be mentioned. The wax on the surface of the fruit has been isolated and studied chemically, and found to possess unique properties. Its production would be rather expensive, however, and its commercial development will probably have to wait for the finding of a special use which can stand the cost.

THE FUTURE

If the accompanying chart had been drawn in 1920, some eight products would have been lacking. By 1930, two more could have been added. Since then, ninguete frozen slices, low-ester pectin, and apple juice essence have been developed, and the present decade may see essence added to the commercial list. We are not betting as yet on malic acid and wax. And there is reason to suppose that the research on apple products going on here and there will result in still other primary products from Apples, the King of Fruits.

Yes Sir, IT'S PER

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NORTHERN GROWTH

Orchard and Garden Mulches

By Clarence E. Baker

MULCHING is as old as plant life itself. It is being constantly demonstrated by the natural mulch or leaf mold that accumulates in all our forests. It is now a standard cultural practice for growing many crops, yet there are still many differences in both fruit and vegetable culture where mulching could be employed to much greater advantage than at present.

When one thinks of a mulch, he probably pictures a strawberry patch with evenly spaced rows of plants and large, luscious, red berries resting upon a bed of straw. One of the functions of the straw is to keep the berries clean by preventing their

straw manure, or with straw to which a liberal application of a nitrogen fertilizer has been applied. The initial mulch should be eight to twelve inches thick and should cover the soil from one foot from the trunk of the tree to a distance about two feet beyond the spread of the branches. This mulch should be replenished each Spring or Fall to make up for settling resulting from the compacting and decomposition of the original mulch. The remainder of the area between the trees may be left in sod.

Small fruits and the bramble kind generally are mulched by covering the entire soil area with a layer of similar thickness. In commer-



contact with the soil. It also contributes in many other ways to the production of those attractive berries. If the ground about the plants had not been covered with a mulch, it is likely that many of the plants would have been heaved on the ground during the winter by the alternate freezing and thawing of the soil. If the weather becomes unseasonably dry before the berries mature, the mulch retards the loss of moisture from the soil. It is true that strawberries can be grown without this mulch

draw, but those who have tried the method are likely to be the first to agree that the results are

disappointing. The *Massachusetts* is so importunate to spreadberry culture, why

Value in growing olden dayans? That when properly used much
importance in growing many crops
can be obtained.

Commercial orchards. Raspberry plantations frequently are very productive patches having regular rows between stone fruit trees.

carrier sold under any of the various trade names is satisfactory. Unless this is done, most of the available nitrogen in the soil may be utilized by the bacteria that decompose the mulching material and a temporary nitrogen shortage is likely to result. A nitrogen deficiency brought about in this manner probably is the greatest cause of unfavorable results occasionally reported following mulching. If manure is used in the mulch, there usually is little need for the nitrogen fertilizer, as sufficient nitrogen is readily available from the manure. For this reason, strawy manure or a mixture of straw and barnyard manure makes a very desirable mulch. Hardwood sawdust is quite widely used as a mulch. Sawdust contains very little nitrogen, so a liberal application of a nitrogen fertilizer should accompany its use. Equal parts of sawdust and barnyard makes an excellent mulch, and with this

mixture a nitrogen fertilizer seldom is necessary. Sawdust from walnut and some coniferous trees are sometimes harmful, due to possible plant absorption of soluble toxic materials. It is therefore safer not to use such sawdust.

A nitrogen shortage following mulching is temporary. After two or three seasons the decaying organic matter of the mulch that becomes incorporated with the soil actually increases the amount of nitrogen that is available to the mulched trees or plants. After the third season, it seldom is necessary

to add a nitrogen fertilizer, even when the mulch is replenished. Mulches function in several ways to bring about conditions in the soil that are favorable for plant growth. They improve the moisture relations very effectively. They encourage the generation of animal life in the soil, both by reducing the surface tension and by improving the soil structure so that water is absorbed more readily. Condensation of moisture from the air has been shown to take place beneath a mulch, thus increasing the soil supply of moisture. Evaporation of moisture from the surface of the soil during hot, dry periods is effectively retarded, and serious moisture losses from deep in the soil is also prevented. The greater resistance of mulched soil to

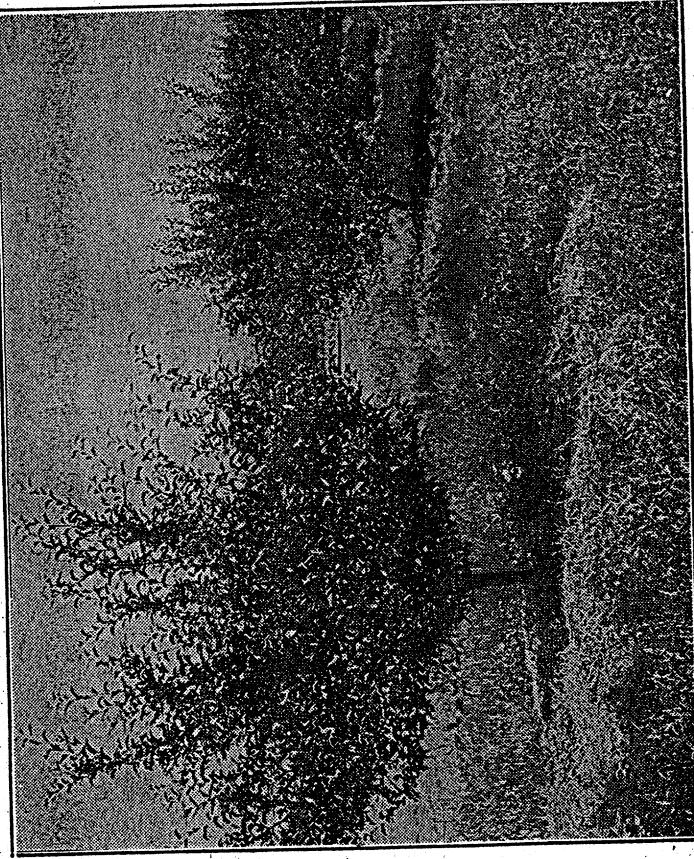
are now grown under various types of mulches. These include stone fruit trees, fruiting bushes, raspberries, blackberries, and black cherries. At the very time we should be pushing it most, mulches prevent moisture loss from deep in the soil is also prevented.

The greater resistance of mulched soil to drying out during extended hot, dry periods appears to provide a condition within the soil that causes plant nutrients to remain more continuously available than in soils subject to alternate moist and dry conditions. As the mulch decays, valuable organic matter and nutrients are added to the soil.

USE FERTILIZER ALSO

WHAT IS A MULCH?

The term "mulch" refers to any material spread over the surface of the soil about growing trees or plants to take the place of cultivation. A mulch should be sufficiently heavy to prevent completely the growth of grass or weeds. Many different materials may be used as mulches. One reason that mulching has not been used more by commercial fruit and vegetable growers is that enormous quantities of material are needed to provide and properly maintain mulches over large acreages. This is not such a serious problem in the home orchard, small fruit planting or vegetable garden, as sufficient material usually can be easily obtained. When crops are grown under irrigation or on deep, loose soils into which water penetrates readily and in which tree roots grow to depths of six feet or more, then mulches are not so important. But when trees or other deep-rooted crops are planted on light clays or shallow soils, mulch culture becomes very important.



Spring is the best time to mulch trees and other garden vegetables.

KINDS OF MULCHES

Mulching materials may be either organic or inorganic in nature. The most common organic mulches are straw, hay, sawdust, marsh grass, meadow grass and shredded corn fodder. Various other materials such as pea vines from canning factories, pressed sorghum cane, various native weeds and grasses, seaweed, shredded waste paper and a host of others are locally available in certain areas. Leaves do not make a good mulch for either strawberries or vegetables, as they pack too tightly together when wet. If it is desired to make use of fallen leaves, they may be mixed with straw and used on tree or bush fruits; otherwise, their place is in the compost pile.

Many inorganic materials are used for more permanent mulches, such as cinders, mine-slack, shale and glass.

While these add no nutrient or organic matter to the soil, they have many of the advantages of organic materials, and are not so likely to cause shortages of soil nitrogen. Their use is limited largely to fruit trees and bush fruits, and they do not share the general popularity of vegetative materials. The use of inorganic materials, especially slack and cinders, on ground that is to be occupied for only a short time is not recommended, because they might be detrimental to any later planted crops.

ADVANTAGES OF MULCHING

On most types of soils of average fertility, mulching has many advantages over cultivation, especially in the home orchard. Too frequently, where tree or bush fruits are grown, they are not cultivated at all, or so infrequently that they make a poor response. Under such conditions, mulching pays big dividends. De-vitalized fruit trees, if free from serious insects and diseases, frequently can be brought into a vigorous and productive condition in a very few seasons if adequately mulched with

bush fruits. At this time of year the ground is moist and mulching helps to retain the favorable condition. Vegetable crops, such as potatoes, beans and all root crops, should be mulched as soon as the plants are high enough that they will not be smothered by the material used. Tomatoes can be mulched within a few days after being transplanted.

When any mulch such as straw or other vegetative material that is low in nitrogen is applied, a nitrogen fertilizer also should be used in liberal amounts. Nitrate of soda, sulphate of ammonia, ammonium nitrate, or a nitrogen